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remaining, through this tendency, less injuriously affected by *adverse* circumstances and consequently might still endure.

(7.) In short, natural selection in the one case might find its fulcrum in the easy adjustment of characters; and in the other case in the inherited persistency in equilibrium, by which the organism would be rendered more or less indifferent to the injurious elements of the environment as well as to its favorable phases.

(8.) The intermediate individuals, by the hypothesis, would be those least fitted to persist in any case, and therefore would be few in number and rapidly eliminated. Then we should have a parallel series of species in two or even more genera, existing simultaneously.

(9.) The above hypothesis would account for the special class coming under the paradox quoted, and has an important bearing on the interpretation of certain embryological changes. For other forms of Saltatory Evolution attention should be directed to the inherited tendency to equilibrium which is the converse of the inherited tendency to vary, but which has hardly been granted the place in the history of evolution to which its importance entitles it. Mr. Darwin, whom nothing escapes, has apparently recognized it in his testimony to the "remarkably inflexible organization" of the goose. Other writers seem to have been chiefly attracted by the converse of this tendency, as, under the circumstances, is most natural.

It seems as if the preceding reasoning might serve as a key to many puzzling facts in nature, and perhaps deprive the catastrophists of their most serviceable weapon.

HINTS ON THE ORIGIN OF THE FLORA AND FAUNA OF THE FLORIDA KEYS.

BY L. F. DE POURTALES.

DURING several seasons passed on or near the Florida reefs and keys, engaged in sounding and dredging in the Gulf Stream, in the service of the United States Coast Survey, I had occasion to make a few observations on the vegetable and animal inhabitants of the islands. They were of course made without system, only in such places where the steamer happened to be in stormy weather, and I have been obliged to complete them as much as possible by the observations of others. Incomplete as they still are, they are given in the hope of drawing the atten-

tion of future visitors to this interesting region to several points in the mode of introduction of plants and animals into a new region, worthy of more extended study.

We have here a curious example, on a very small scale to be sure, of land of comparatively recent origin, which has received its flora and fauna from two different and very distinct sources, the West Indies and the North American Continent, and, as it seems, the flora chiefly from the former, the fauna mostly from the latter.

For a proper understanding of the subject I must refer to the description of the Florida keys and reefs, by Professor Agassiz, in the Coast Survey Report for 1851 (it was never published *in extenso*), and in his *Methods of Study*; also to an able paper on the same subject, by the late Lieut. E. B. Hunt, of the United States Engineers, in the Coast Survey Report for 1862, and the *American Journal of Science*, vol. xxxv.

Lieutenant Hunt expresses the opinion that the reefs and keys shoot out as it were by their western end into the deep waters of the Gulf of Mexico. He says, "The well-traced curve along which this grand Florida bank thrusts itself out into the deep waters of the gulf is strikingly significant of some continuous and regular agency in its production. The adjacent flow of the Gulf Stream would most naturally be assumed to govern in some way the production of this curve. It however runs in the contrary direction to serve this explanatory use, and it is in fact rarely found to run close in upon the reef. There is, however, an eddy, countercurrent, intermitting in character and of variable rate, but on the whole a positive and prevailing current." We have not, unfortunately, observations enough of the currents near the reef to confirm these remarks otherwise than by a few scattered and often contrary ones, but judging by the effects, the above statement is undoubtedly true, and theoretically we should expect to find a countercurrent in the concave side of a bend of the main current. To the effect of this eddy ought to be added the still more regular westward action of the trade-wind and the flood tide. The formation of new islands and the westward extension of the reef are, however, probably of more than secular slowness, and the first discoverers of what was then called The Martyrs found them very nearly as we see them now. We may even have to record periods of retrogression as we do in glaciers, when a period of exceptionally frequent or violent hurricanes destroys more than the growth of corals and the piling up of their *débris* can supply.

Thus in the past forty years, Looe Key, part of Sand Key, and North Key, at the Tortugas, have been swept off and replaced by shoals.

The actual western termination of the system of keys is at Loggerhead Key, one of the Tortugas, but shoal ground extends some twenty miles farther west. The reef proper terminates opposite the Marquesas, about forty miles east of the Tortugas. The ancient reef which preceded the one which formed the keys did not extend as far west by more than one hundred miles, terminating about Cape Sable.¹

The formation of the keys to the westward of Key West plainly shows their more recent origin. The Tortugas consist mostly of coarse coral sand, sometimes unconsolidated, sometimes, as at Loggerhead Key, forming a soft rock, quite different from the harder limestone of Key West. At Loggerhead its very recent origin is plainly seen by its containing occasionally pieces of metal from wrecks, such as bolts, nuts, nails, etc. East Key of the same group seems to be washing away at its southern end and forming anew at the north. North Key, which has been mentioned as having disappeared, is said to have had the only well of fresh water in the group. It was explained by my informant, probably correctly, as having been composed of very fine sand, more apt to retain the rain-water unmixed than the coarser sand of the other keys.

The marine fauna of the coral region of South Florida is a West Indian colony engrafted on the more or less North American fauna of the east and west coasts of the peninsula. From Cape Florida and from Cape Sable northward the reef corals and their commensals are not found, the calcareous is replaced by silicious sand, oyster banks fill the bays, and a great change is apparent by a mere look at the prevailing shells thrown up on the beaches.

The flora of the keys is very largely West Indian in its origin. Mr. Frederick Brendel has given in vol. viii. No. 8, of this journal, interesting remarks on the species of plants common to

¹ I would urge on the winter excursionists to that part of our country the exploration of the region of the Everglades, northwest of the Miami River, with regard to the number and distances of ancient reefs, which ought to assume the form of rocky islands in the marshes. Long Key in the Everglades, by its shape and parallelism to the known ancient reefs, must be of that character, and there are probably more. The fossil corals found in them would be of interest to compare with more recent ones. It would be desirable to know also how far north of Cape Florida coral rock extends along the coast. I take this opportunity to say that the Museum of Comparative Zoölogy in Cambridge would be thankful for a set of the fossil corals of Tampa Bay.

South Florida, the West Indies, and Mexico, to which I refer the reader. I would only state that the anomaly noticed by Mr. Brendel in the number of species common to South Florida and Mexico being so much smaller than those common to the former and the West Indies can hardly be explained by a former connection of the land as he seems to imply. The distribution of animals, as we shall see, would not bear out this theory.

No botanist, as far as I can find, has made a discrimination between the flora of the keys proper and that of the mainland of South Florida; it would no doubt show that some of the few plants common to Northern and Southern Florida do not extend to the islands; the pine is a conspicuous example, its growth being apparently incompatible with pure calcareous soil; the Pine Keys, back of the main range, are the only ones bearing a growth of pines, and they have silicious sand, as I was informed by Professor Agassiz. I have often regretted not having visited them. Seen from the middle of Key Biscayne Bay the difference between the mainland and the keys is quite conspicuous. The border of mangroves is of course the same on both sides, but above it on the former the horizon is closed by the pine forest so characteristic of the shores of the Southern States, while on the latter the larger trees are fig-trees of two or three species, the quassia (*Simaruba*), the torchwood (*Bursera*), the mahogany, and a few others, interspersed with a dense shrubbery, in which several species of *Eugenia* are perhaps the most common and characteristic. Near the water the *Coccoloba*, or sea-grape, forms conspicuous groups, and on muddy shores the mangrove and the *Avicennia*, called locally the black mangrove, are always ready to consolidate the new-made land, the former by its air roots and numerous floating fruits, the latter by its creeping roots. In sandy places the palmetto seems to monopolize the ground, but never rises to more than ten or fifteen feet.

The tree vegetation seems to be most luxuriant, comparatively speaking, about the central part of the chain of keys, say from Key Largo to Key West. At Key West it has an appearance of decline, though it is hardly a fair point of comparison, as most of the trees suitable for fire-wood have been destroyed and many trees and plants introduced which have changed the aspect of the vegetation. West of this, however, the change becomes more marked, until finally we reach the Tortugas, where I made it a point to try to collect every plant growing on the group. I think I nearly succeeded, and obtained only fourteen species, which my

friend, Mr. Lesquereux, had the kindness to determine for me. They are *Suriana maritima*, the largest shrub covering most of the islands, improperly called bay-cedar by the inhabitants; *Tournefortia gnaphaloides*; *Avicennia tomentosa*, a few crippled specimens on Bush Key, and also growing on the parade ground of Fort Jefferson; *Scaevola Plumieri*; *Euphorbia glabella*, *Cordia bullata*, probably introduced near the light-house; *Ambrosia erithmifolia*; *Nasturtium tanacetifolium*; *Battatas littoralis*; a large *Opuntia*, probably introduced; an undetermined *Labiata*; *Cenchrus tribuloides*; *Cyperus microdontus* and *Eragrostis macrantha*.

This scarcity of plants may be attributed to various causes, but the principal one is no doubt the more recent formation of these islands, more imperfect consolidation, and the as yet insufficient accumulation of vegetable soil. The distribution of seeds may also be influenced by the currents in such a way as to be left in greater numbers on the keys farther east, which would be first touched by the eddy currents of the Gulf Stream; but this question I would only touch upon under great reserve.

It would be an interesting study for a resident botanist to collect the numerous seeds thrown on the beaches of Florida and test their germinative powers. Some kinds seem to germinate, but still not to grow up to maturity. Thus I have seen the cocoanut germinating among the rubbish thrown up by the sea, but do not recollect seeing a tree grown up under such circumstances, although it does well under cultivation. Among the most common and conspicuous seeds found on the beaches are the large beans of *Entada gigalobium*, so well protected by their hard skin that they stand transportation by the Gulf Stream as far as Spitzbergen. Yet they do not germinate in Florida, so far as I know.

The land animals, as has been stated, are mostly immigrants from the mainland, with some exceptions which will be noted. The few mammals are entirely North American, and it is interesting to note how far the different species have penetrated along the chain of islands. For much of this information I am indebted to Colonel Patterson, one of the oldest residents of Key West, and a keen sportsman in his younger days. The deer and the raccoon have wandered as far as Key West; beyond this no mammals are found. The deer is probably destroyed at present, but the raccoon is still not uncommon. There may be a small rodent in addition, and perhaps the aquatic rabbit of the Southern

States. The bear does not extend so far—I think only to Matcumbe—and is probably only a visitor at the time when the turtles lay their eggs, of which he is said to be very fond; there would be little food for him at other times. Key Largo which is connected by a narrow isthmus with the mainland has the mammals of the latter, opossums, squirrels, etc. A burrowing rabbit, according to Colonel Patterson, is found on Rabbit Key, a very small and isolated islet in the bay or sound between the mainland and the keys. To reach Key West from Key Largo, some fifteen or more channels (some of them three or four miles wide) have to be crossed in passing from island to island. The want of fresh water is the probable inducement for the undertaking.¹ The absence of North American mammals from Cuba and the Bahamas would seem to give a great antiquity to the present course of the Gulf Stream which has proved an impassable barrier.

Of birds little can be said on account of their wandering habits. After hurricanes, birds from Cuba are often taken here, which are not seen at other times. A list of the regular breeding birds would be interesting.

For the batrachia and reptiles I can only give a list for Key West, kindly made up for me by Mr. Garman from the collection in the Museum of Comparative Zoölogy. The batrachia are *Hyla cinerea* and *Scaphiopus solitarius*; the snakes, *Tropidonotus compressicaudus*, *Coryphodon constrictor* (Tortugas), *Elaphis obsoletus* and *guttatus*, *Liopeltis æstivus*, *Crotalus adamanteus*; the saurians, *Plestiodon quinquelineatus*, *Cnemidophorus sexlineatus*, *Anolis principalis*, and *Sphærodactylus notatus*. The chelonians are represented by *Thyrosternum Pennsylvanicum*; the salt-water terrapin is said to be found at the Marquesas, between Key West and the Tortugas, but I have never seen a specimen.

All of these, with the exception of *Sphærodactylus*, from Cuba, are North American species. The batrachia are said by Wallace to be very seldom represented in insular faunæ, being rapidly killed by salt water. The two species mentioned above may have been transported with soil from the mainland, which has been sometimes brought to enrich the gardens.

Of the insects I cannot speak. There will be probably found here a considerable mixture of North American, Cuban, and

¹ While on the subject of mammals I would mention that a very imperfectly known West Indian seal is found occasionally in numbers on the Dog rocks, north-east corner of Salt Key Bank, about one hundred miles from Key West.

Bahamian forms, as the distances are not too great to be traversed by most flying insects. It would be an interesting study for an entomologist to find out how far North American species have adapted themselves to the West Indian flora, and how far they have varied under this influence.

With regard to the land shells, I am enabled by the kindness of Mr. Thomas Bland, to give more extended lists than in the other departments. Mr. Bland, not content to give me the benefit of his own large stock of knowledge, has spared no pains to gather all the information within reach, principally from Mr. W. G. Binney and Mr. W. W. Calkins.

Mr. Binney remarks that the fauna of the keys is quite the same as that of the mainland from Tampa Bay to the Miami River, and that this fauna is about equally derived from the great "Southern Province" of the eastern region of North America and from the West Indies, and gives the following lists in corroboration:—

SPECIES CERTAINLY DERIVED FROM THE "SOUTHERN REGION" OF NORTH AMERICA, NOT FROM WEST INDIES.	WEST INDIAN SPECIES FOUND IN FLORIDA.
<p><i>Glandina truncata</i>, everywhere. <i>Succinea campestris</i>, Key West. <i>Polygyra Carpenteriana</i>, Key West, Key Biscayne. <i>Polygyra septemvolva</i>, Key West. <i>" cereolus</i>, " <i>" uvulifera</i>, " <i>Pupa variolosa</i>, " <i>" modica</i>, " <i>" rupicola</i>, " <i>Helix pulchella</i>, " <i>Zonites minusculus</i>, " <i>Helicina orbiculata</i>, "</p>	<p><i>Zonites Gundlachi</i>, Key West. <i>Patula vortex</i>, mainland and keys. <i>Helix varians</i>, Key West to Key Biscayne. <i>Cylindrella Foeyana</i>, Miami River, Key West. <i>Macroceranus pontificus</i>,¹ Miami River to Tampa. <i>Macroceranus Gossei</i>, Little Sarasota Bay. <i>Bulinus marietinus</i>, Miami River. <i>Strophia incana</i>, mainland and keys. <i>Stenogyra octonoides</i>, Miami River. <i>Stenogyra gracillima</i>, Miami River, Key West. <i>Lignus fasciatus</i>, Miami River, Key West. <i>Orthalicus undatus</i>, " " <i>Chondropoma dentatum</i>, Miami River, Key West. <i>Cylindrella jejuna</i>, Miami River, Key West.</p>

From Mr. Calkins' list I add *P. incana* from Key West to Key Biscayne. That some species which are common to some of the West India Islands and to South Florida have had their origin in North America and spread from there, as stated by Mr. Binney, is a fact very difficult to account for. The currents are decidedly against it, and a former connection of the land not confirmed by a study of other classes.

We may recapitulate as follows from these notes, imperfect as

¹ Key West (Calkins).

they are: (1.) The vegetation of the Florida Keys is largely West Indian. (2.) The mammals are entirely North American, and no species common to Florida and West Indies, except perhaps some bats and the manatee,¹ which are not properly attached to the land. (3.) Reptiles and batrachia, North American with only one exception. The Cuban crocodile, lately discovered in South Florida, is never found on the keys. (4.) Land shells are about equally divided, with a slight preponderance of West Indian species.

On the whole, therefore, this small region is well entitled to be called a curious instance of intermingling of faunas, and worthy of being carefully studied in all its details, aside from the great interest it presents to the naturalist in its marine fauna and flora, and to the geologist as a working model of many of the agencies by which a large proportion of the sedimentary rocks have been formed.

A PROVISIONAL HYPOTHESIS OF PANGENESIS.²

BY W. K. BROOKS.

THE value of Darwin's Provisional Hypothesis of Pangenesis, as a legitimate attempt at a scientific interpretation of the facts of reproduction, is so evident that no apology for endeavoring to discuss the subject is necessary. I venture then to call attention to the following attempt to combine the hypotheses of Owen, Spencer, and Darwin in such a way as to escape the objections to which each is in itself liable, and at the same time to retain all that renders them valuable.

All characteristics which are fully established as peculiarities of the species are transmitted through the various forms of asexual reproduction, as well as by the ovum, which has in itself the power to develop, when excited by a proper stimulus which may or may not be the effect of impregnation, into a new individual of the parent form.

New characteristics, on the contrary, are transmitted through the agency of gemmules, which are thrown off by the cells implicated in the variation. These gemmules have not, like the ovum, power to develop into a new individual, but reproduce under

¹ The comparatively abundant fragments of manatee bones found by me in dredging off the Florida coast seem to indicate former migrations of that animal between Cuba and Florida. I believe it is not known now to leave the shores.

² Abstract of a paper read at the Buffalo meeting of the American Association for the Advancement of Science, August 23, 1876.